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MEMORANDUM

TO: Russell Barnett, Deputy Commissioner
Department for Environmental Protection

Michael Mills, Environmental Biologist Chief
Water Quality Branch
Division of Water

THRU: William E. Davis, Director
Division of Environmental Services

FROM: Albert G. Westerman, Ph.D., Manager
Risk Assessment Branch

DATE: February 27, 1996

SUBJECT: Potential Risks to People from Consuming Fish from Chickasaw Park, Louisville
(Identification #: TB-384)

Fish were collected by the Ecological Support Section, Division of Water from Chickasaw Park Lake, Louisville, Kentucky and shipped to Heritage Environmental Services, Inc., Indianapolis, Indiana for analyses of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (August 10, 1995). Lake sediment samples were collected on December 15, 1995 and also analyzed for dioxins and furans. This group of over one hundred chemical isomers are often referred to as dioxins, due in part, to their similar toxic action.

Although two species of fish were collected from the park lake in August, only carp (Cyprinus carpio) was initially analyzed and reported on October 26, 1995. It should be noted that dioxin analysis costs approximately \$1,200.00 per sample, a fact that keeps government agencies from conducting extensive analyses. Analysis of the second species collected, white crappie (Pomoxis annularis), the sediment sample and the carp (reanalysis) were completed on February 21, 1996.

The results of the fish-fillet dioxin analysis were assessed using a risk-based approach developed by the United States Environmental Protection Agency (USEPA 1989). The approach assumes that at least eight meals of 10 ounces (0.284 Kg) of fish will be eaten per year. It further assumes that fish will be eaten from this source for at least 30 years. The risk-



based procedures involve a series of calculations to determine potential intakes of contaminants, the intakes are then compared to levels known to be toxic to determine the risk from eating fish. Considering the small lake size and the apparent depaupered state of the fish populations that are apparently present in the lake, these assumptions may be over-estimates of actual fish consumption from the lake and potential risks to area people.

Initially the dioxin/furan data is multiplied by isomer specific toxicity equivalency factors to convert the various isomers to the equivalency of 2,3,7,8-tetrachlorodibenzodioxin (TCDD), a chemical isomer for which a nationally published cancer slope factor (cancer strength) is available. The result was a 2,3,7,8-TCDD toxicity equivalency for the Chickasaw Lake samples of 2.43×10^{-6} mg/Kg for the crappie, 17.74×10^{-6} mg/Kg for the October 26, 1995 carp analysis and 13.77×10^{-6} mg/Kg for the February 21, 1996 reanalysis of the carp sample. The USBPA national cancer slope factor for dioxin is 1.56×10^5 (mg/Kg-day)⁻¹.

This information is then fed into the following formulas to determine risk levels.

I) Ingestion of Contaminated Fish Calculations

$$\text{Intake (mg/Kg-day)} = \frac{CF \times IR \times FI \times EF \times ED}{BW \times AT}$$

CF	=	Contaminant Concentration in Fish - milligrams/Kilograms (mg/Kg)
IR	=	Ingestion Rate (Kg/meal) - 0.284 Kg/meal (10 ounces)
FI	=	Fraction Ingested from Contaminated Source - 1.0
EF	=	Exposure Frequency (meals/year) - 8
ED	=	Exposure Duration (years) - 30 years
BW	=	Body Weight (Kg) = 70 Kg
AT	=	Averaging Time (period over which exposure is averaged in days)(cancer 70 years x 365 days/year)

1. Carp (October 26, 1995 analysis)

$$\begin{aligned} \text{A. Intake} &= \frac{17.741 \times 10^{-6} \text{ (mg/Kg)} \times 0.284 \text{ (Kg/meal)} \times 1.0 \times 8 \text{ (meals/year)} \times 30 \text{ years}}{70 \text{ Kg} \times 25550 \text{ days}} \\ \text{Intake} &= 6.76 \times 10^{-10} \text{ mg/Kg-day} \end{aligned}$$

$$\text{B. Risk} = \text{Cancer Slope Factor} \times \text{Intake}$$

$$\text{Risk} = 1.56 \times 10^5 \text{ (mg/Kg-day)}^{-1} \times 6.76 \times 10^{-10} \text{ (mg/Kg-day)} = 0.000105473 \text{ or } 1 \times 10^{-4}$$

∴ Individual Risk of One in 10,000

2. Carp (February 21, 1996 analysis)

$$A. \text{ Intake} = \frac{13.77 \times 10^{-6} \text{ mg/Kg} \times 0.284 \text{ (Kg/meal)} \times 1.0 \times 8 \text{ (meals/year)} \times 30 \text{ years}}{70 \text{ Kg} \times 25550 \text{ days}}$$
$$\text{Intake} = 5.25 \times 10^{-10} \text{ mg/Kg-day}$$

B. Risk = Cancer Slope Factor x Intake

$$\text{Risk} = 1.56 \times 10^{-5} \text{ (mg/Kg-day)}^{-1} \times 5.25 \times 10^{-10} \text{ mg/Kg-day} = 0.0000819 \text{ or } 8 \times 10^{-5}$$

∴ Individual Risk of Eight in 100,000

3. Crappie (February 21, 1996 analysis)

$$A. \text{ Intake} = \frac{2.43 \times 10^{-6} \text{ mg/Kg} \times 0.284 \text{ (Kg/meal)} \times 1.0 \times 8 \text{ (meals/year)} \times 30 \text{ years}}{70 \text{ Kg} \times 25550 \text{ days}}$$
$$\text{Intake} = 9.26 \times 10^{-11} \text{ mg/Kg-day}$$

B. Risk = Cancer Slope Factor x Intake

$$\text{Risk} = 1.56 \times 10^{-5} \text{ (mg/Kg-day)}^{-1} \times 9.26 \times 10^{-11} \text{ mg/Kg-day} = 0.000014446 \text{ or } 1 \times 10^{-5}$$

∴ Individual Risk of One in 100,000

II. Sediment Toxicity Equivalent Concentrations:

The calculated toxicity equivalent concentration (TEQ) for the sediment sample is 4.62×10^{-6} mg/Kg dioxins. The TEQ average for dioxins in sediments nationwide is 3.91×10^{-6} mg/Kg (USEPA 1993). Chickasaw Lake sediments are approximately 20% higher than the national average.

Conclusion:

1. Kentucky Department for Environmental Protection considers individual risk of greater than one in one million as unacceptably high. Based on a risk approach, no fish should be consumed from the Chickasaw Park Lake.
2. Lake sediment dioxin/furan concentrations are elevated over national levels and potentially are the source of the contaminants in the fish.

Recommendations:

1. Anyone consuming crappie from Chickasaw Park Lake should limit their intake to no more than one meal a year.

2. Consumption of high fat species such as carp from the lake should be banned.
3. Without data on other species that may be caught in the lake, little can be said about their consumption. Eating larger fish of any species from the park lake is not recommended.
4. It is our understanding that the lake has been previously dredged with some of the dredged material potentially stacked on the banks. Sampling of the bank soils for dioxins would indicate if this soil is contributing to sediment concentrations.

c: Pam Woods

References Cited

United States Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund, Volume I -- Environmental Evaluation Manual, Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002.

United States Environmental Protection Agency (USEPA). 1994. Estimating Exposure to Dioxin-Like Compounds. Volume I, II, III. Office of Research and Development, Washington, D.C. EPA/600/6-88/005C.